

RECEIPT OF FILINGS
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

This paper, when stamped with the date stamp of the U. S. Patent and Trademark Office, acknowledges receipt of the following paper(s) relating to:

In re Patent Application of

Keiichiro OISHI

Serial No.: 09/983,029

Filed: October 22, 2001

For: COPPER/ZINC ALLOWS HAVING
LOW LEVELS OF LEAD AND GOOD
MACHINABILITY

) Attorney Docket No.: SUGI0085

) Confirmation No.: 8194

) Group Art Unit: 1742

) Examiner: Sikyin IP



Documents submitted April 9, 2004

1. Form PTO-2038 Credit Card Payment Form in the amount of \$950.00
2. Form PTO/SB/21 Transmittal Form
3. Form PTO/SB/17 Fee Transmittal for FY 2004 in duplicate
4. Form PTO/SB/22 Petition for Extension of Time in duplicate
5. Request for Reconsideration Under 37 CFR 1.111 (22 pages)
6. Declaration of Keiichiro Oishi Under 37 CFR 1.132 (22 pages) and Exhibits A-D (4 pages)

Dkt. #SUGI0085

Due: 4/9/04 (JUS/cjf)

PTO/SB/21 (08-03)

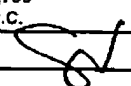
Approved for use through 08/30/2003. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM (to be used for all correspondence after initial filing)	Application Number	09/983,029	
	Filing Date	October 22, 2001	
	First Named Inventor	Keiichiro OISHI	
	Art Unit	1742	
	Examiner Name	Sikyin IP	
Total Number of Pages In This Submission	53	Attorney Docket Number	SUGI0085

ENCLOSURES (Check all that apply)		
<input checked="" type="checkbox"/> Fee Transmittal Form	<input type="checkbox"/> Drawing(s)	<input type="checkbox"/> After Allowance communication to Technology Center (TC)
<input checked="" type="checkbox"/> Fee Attached	<input type="checkbox"/> Licensing-related Papers	<input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences
<input checked="" type="checkbox"/> Amendment/Reply	<input type="checkbox"/> Petition	<input type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief)
<input type="checkbox"/> After Final	<input type="checkbox"/> Petition to Convert to a Provisional Application	<input type="checkbox"/> Proprietary Information
<input type="checkbox"/> Affidavits/declaration(s)	<input type="checkbox"/> Power of Attorney, Revocation	<input type="checkbox"/> Status Letter
<input checked="" type="checkbox"/> Extension of Time Request	<input type="checkbox"/> Change of Correspondence Address	<input checked="" type="checkbox"/> Other Enclosure(s) (please identify below):
<input type="checkbox"/> Express Abandonment Request	<input type="checkbox"/> Terminal Disclaimer	Declaration of Keiichiro Oishi Under 37 CFR 1.132
<input type="checkbox"/> Information Disclosure Statement	<input type="checkbox"/> Request for Refund	
<input type="checkbox"/> Certified Copy of Priority Document(s)	<input type="checkbox"/> CD, Number of CD(s) _____	
<input type="checkbox"/> Response to Missing Parts/Incomplete Application	Remarks	
<input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT	
Firm or Individual name	Joerg-Uwe Szpl Registration No. 31,799 GRIFFIN & SZIPL, P.C.
Signature	
Date	April 9, 2004

CERTIFICATE OF TRANSMISSION/MAILING	
I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below.	
Typed or printed name	
Signature	Date

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/17 (10-03)

Approved for use through 07/31/2008. OMB 0651-0032

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27TOTAL AMOUNT OF PAYMENT (\$)**950.00**

Complete If Known

Application Number	09/983,029
Filing Date	October 22, 2001
First Named Inventor	Keiichiro OISHI
Examiner Name	Sikylin IP
Art Unit	1742
Attorney Docket No.	SUGI0085

METHOD OF PAYMENT (check all that apply)

☐ Check ☒ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account:

Deposit Account Number: **501281**

Deposit Account Name: **Griffin & Szipl, P.C.**

The Director is authorized to: (check all that apply)

☐ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
1001 770	2001 385	Utility filing fee	
1002 340	2002 170	Design filing fee	
1003 530	2003 265	Plant filing fee	
1004 770	2004 385	Reissue filing fee	
1005 160	2005 80	Provisional filing fee	
SUBTOTAL (1)			(\$) 0.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

Total Claims - 20** = X =

Independent Claims - 3** = X =

Multiple Dependent =

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description
1202 18	2202 9	Claims in excess of 20
1201 86	2201 43	Independent claims in excess of 3
1203 290	2203 145	Multiple dependent claim, if not paid
1204 86	2204 43	** Reissue independent claims over original patent
1205 18	2205 9	Reissue claims in excess of 20 and over original patent
SUBTOTAL (2)		

SUBTOTAL (2) (\$)**0.00**

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
1051 130	2051 65	Surcharge - late filing fee or oath	
1052 50	2052 25	Surcharge - late provisional filing fee or cover sheet	
1053 130	1053 130	Non-English specification	
1812 2,520	1812 2,520	For filing a request for <i>ex parte</i> reexamination	
1804 920*	1804 920*	Requesting publication of SIR prior to Examiner action	
1805 1,840*	1805 1,840*	Requesting publication of SIR after Examiner action	
1251 110	2251 55	Extension for reply within first month	
1252 420	2252 210	Extension for reply within second month	
1253 950	2253 475	Extension for reply within third month	950.00
1254 1,480	2254 740	Extension for reply within fourth month	
1255 2,010	2255 1,005	Extension for reply within fifth month	
1401 330	2401 165	Notice of Appeal	
1402 330	2402 165	Filing a brief in support of an appeal	
1403 290	2403 145	Request for oral hearing	
1451 1,510	1451 1,510	Petition to institute a public use proceeding	
1452 110	2452 55	Petition to revive - unavoidable	
1453 1,330	2453 665	Petition to revive - unintentional	
1501 1,330	2501 665	Utility issue fee (or reissue)	
1502 480	2502 240	Design issue fee	
1503 640	2503 320	Plant issue fee	
1460 130	1460 130	Petitions to the Commissioner	
1807 50	1807 50	Processing fee under 37 CFR 1.17(q)	
1806 180	1806 180	Submission of Information Disclosure Stmt	
8021 40	8021 40	Recording each patent assignment per property (times number of properties)	
1809 770	2809 385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810 770	2810 385	For each additional invention to be examined (37 CFR 1.129(b))	
1801 770	2801 385	Request for Continued Examination (RCE)	
1802 900	1802 900	Request for expedited examination of a design application	

Other fee (specify)

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)**950.00**

SUBMITTED BY

Name (Print/Type) **Joerg-Uwe Szipl**

Registration No. (Attorney/Agent)

31,799

(Complete if applicable)

Telephone **703-979-5700**

Signature

Date **April 9, 2004**

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

This collection of information is required by 37 CFR 1.17 and 1.27. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.

SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

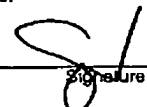
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/22 (08-03)

Approved for use through 7/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional) SUGI0085	
		In re Application of Keiichiro OISHI	
		Application Number 09/983,029	Filed October 22, 2001
		COPPER/ZINC ALLOYS HAVING LOW LEVELS OF LEAD AND GOOD FOR MACHINABILITY	
		Art Unit 1742	Examiner Sikyin IP
This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.			
The requested extension and appropriate non-small-entity fee are as follows (check time period desired):			
<input type="checkbox"/> One month (37 CFR 1.17(a)(1))		\$ <u>110.00</u>	
<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))		\$ <u>420.00</u>	
<input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))		\$ <u>950.00</u>	
<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))		\$ <u>1480.00</u>	
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))		\$ <u>2010.00</u>	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. Therefore, the fee amount shown above is reduced by one-half, and the resulting fee is: \$ _____.			
<input type="checkbox"/> A check in the amount of the fee is enclosed.			
<input checked="" type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.			
<input type="checkbox"/> The Director has already been authorized to charge fees in this application to a Deposit Account.			
<input checked="" type="checkbox"/> The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>501281</u> .			
I have enclosed a duplicate copy of this sheet.			
I am the <input type="checkbox"/> applicant/inventor.			
<input type="checkbox"/> assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).			
<input checked="" type="checkbox"/> attorney or agent of record. Registration Number <u>31,799</u>			
<input type="checkbox"/> attorney or agent under 37 CFR 1.34(a). Registration number if acting under 37 CFR 1.34(a) _____			
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.			
<u>April 9, 2004</u>			
Date		Signature	
<u>(703) 979-5700</u>		Joerg-Uwe Szpl	
Telephone Number		Typed or printed name	
NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.			
<input checked="" type="checkbox"/> Total of _____ forms are submitted.			

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:) Atty. Docket: **SUGI0085**
Keiichiro OISHI) Confirmation No.: 8194
Serial No. 09/983,029) Group Art Unit: 1742
Filed: October 22, 2001) Examiner: Sikyin IP
For: COPPER/ZINC ALLOYS HAVING)
LOW LEVELS OF LEAD AND) Date: April 9, 2004
GOOD MACHINABILITY)

REQUEST FOR RECONSIDERATION UNDER 37 C.F.R. § 1.111

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the non-final Office Action dated October 9, 2003 regarding the above captioned application, Applicant respectfully requests reconsideration and allowance of the instant application in view of the following remarks and attached Declaration of Keiichiro Oishi under Rule 1.132 ("Oishi Decl.").

Serial No. 09/981,029
SUGI0085

Page 2

REMARKS

As an initial matter, Applicant asserts the adequacy of the Japanese Language Declaration filed on January 11, 2002 in the present case. The Examiner has objected to this Declaration for failing to meet multiple formalities required by the United States Patent and Trademark Office (USPTO), (Office Action, dated October 9, 2003, page 2, lines 1-13). However, the Declaration is an official USPTO form, and its boiler plate language is believed to meet the formal requirements of the USPTO. There is no assertion that the form has been incorrectly completed. Rather, the Examiner objects to this official form as failing to meet the formal requirements of the Patent Office.

On October 29, 2003, W. Scott Ashton (Reg. No. 47,395) contacted Mr. Roy King at 703-308-1146 to discuss the Declaration. Mr. King is a supervisor for Examiner Ip. Mr. King confirmed that the Japanese Language Declaration filed on January 11, 2002, in the present case met all formal requirements of the USPTO. Therefore, Applicant believes the Examiner's objection to the Declaration has been overruled.

Applicant also gratefully acknowledges the Examiner's Interview held on December 16, 2003 (See Interview Summary, dated December 16, 2003). During this interview, both Examiner Ip and Mr. Joerg-Uwe Szipl, Applicant's representative, agreed that U.S. Patent No. 5,582,281 to Nakashima et al. represented the closest prior art of record.

The Invention

The present invention pertains broadly to free-cutting copper alloys, having low lead contents, good machinability and corrosion resistance, such as would be used in manufacturing water faucets, water supply/drainage metal fittings and valves, and other similar components of water supply lines. A first embodiment of the present invention

Serial No. 09/983,029
SUGI0085

Page 3

provides a free-cutting copper alloy, consisting essentially of (a) 69 to 79 percent, by weight, of copper; (b) 2.0 to 4.0 percent, by weight, of silicon; (c) 0.02 to 0.4 percent, by weight, of lead; and (d) a remaining percentage, by weight, of zinc, wherein the percent by weight of copper and silicon in the copper alloy satisfy the relationship $60 \leq X - 3Y \leq 70$, wherein X is the percent, by weight, of copper, and Y is the percent, by weight, of silicon; and the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase.

Various other free-cutting copper alloy embodiments are recited in the remaining independent and dependant claims. However, all of the free-cutting copper alloy embodiments in accordance with the present invention have the advantage of lower Pb contents than those of the prior art while maintaining industrially acceptable machinability and corrosion resistance characteristics. The free-cutting copper alloys in accordance with the present invention are all endowed with this advantage because the metal phase construction is formed so that the total phase area comprises not more than 5% of a β phase. In other words, to maintain industrially acceptable machinability and corrosion resistance properties despite the relatively low lead contents, the Cu-Zn(Pb) alloys made in accordance with the present invention all have a percentage of β phase that is kept within the critical range of not more than 5% of the total phase area. Cu-Zn(Pb) alloys made in accordance with the present invention also include some component of at least one of a γ phase, a κ phase, or a μ phase.

Serial No. 09/983,029
SUGI0085

Page 4

The Rejection

Claims 1-14 stand rejected under 35 U.S.C. § 103(a) as unpatentable over any one of the following: (a) JP 62-297429 (hereafter, "JP'429"), (b) JP 03-068733 (hereafter, "JP'733"), (c) U.S. Patent 5,942,056 to Singh (hereafter, the "Singh Patent"), (d) WO 9810105 (hereafter, "WO'105"), (e) JP 62-274036 (hereafter, "JP'036"), and (f) U.S. Patent 5,582,281 to Nakashima et al. (hereafter, the "Nakashima Patent").

Applicant respectfully traverses the rejection and requests reconsideration of the present application for the following reasons.

Applicant's Arguments

As acknowledged by the Examiner (Office Action, dated October 9, 2003, page 2, lines 15-22), to establish an obviousness rejection under 35 U.S.C. § 103, the examiner must (1) determine the scope and content of the prior art; (2) ascertain the differences between the prior art and the claimed invention; (3) resolve the level of ordinary skill in the art; and (4) determine the effect on patentability of secondary considerations that are relevant indicia of obviousness or nonobviousness. 148 U.S.P.Q. 459, 467 (1966). In the present case, first the scope and content of the prior art will be reviewed and the adequacy of the obviousness rejection is challenged. Second, the Examiner's obviousness rejection is additionally rebutted with objective evidence of nonobviousness provided in the Declaration of Keiichiro Oishi, filed concurrently herewith (hereafter, the "Oishi Decl.").

Serial No. 09/983,029
SUGI0085

Page 5

Scope and Content of the Prior Art

The Nakashima Patent: the closest prior art

The Nakashima Patent teaches a "method of connecting a sliding ring member to a synchronizer ring," which includes the disclosure of a wear-resistant copper alloy containing 22-45 wt % of Zn, 0.1 to 15 wt % of at least one kind of metal element such as Pb, and a remaining amount of copper and impurities (See Nakashima, Abstract). It is also required that these wear-resistant copper alloys have a metal phase matrix that is either an $\alpha+\beta$ matrix, a solely β matrix, or a $\beta+\gamma$ matrix (See Nakashima, Abstract). Another required feature of these copper alloys is that they are wear-resistant and have a Hardness Rockwell B value of more than 80 (See Nakashima, Abstract). Those skilled in the art would instantly recognize that copper alloys made in accordance with the teachings of the Nakashima Patent are hard, rigid metals with poor machinability and unsuited for the manufacture of water faucets, water supply/drainage metal fittings and valves, and other similar components of water supply lines.

While Applicant and the Examiner agree that the copper alloys taught by Nakashima represent the closest prior art (See Examiner's Interview Summary, dated December 16, 2003), there are major differences between the copper alloys taught by Nakashima and the Cu-Zn(Pb) alloys of the present invention.

First, while Nakashima teaches generally that there must be at least wt 22-45 % of Zn in the alloy, the only specific example of a Cu-Zn(Pb) alloy (i.e., Nakashima, Example D in Table 1) contains 38% by weight of Zn, which means less than 65 wt % of Cu. Consequently, the Nakashima Patent does not explicitly teach, or even suggest, a free-cutting Cu-Zn(Pb) alloy having "69 to 79 percent, by weight, of copper" as recited in claims 1-14 of the present invention.

Serial No. 09/983,029
SUGI0085

Page 6

Second, the Nakashima Patent teaches the desirability of predominately β phase metal constructions (i.e., $\alpha+\beta$ matrix, a solely β matrix, or a $\beta+\gamma$ matrix). On the other hand, the present invention endeavors to "limit the amount of β phase in the α matrix of the metal construction" because "if the copper alloy has less than about 30% α phase...the copper alloy is not cold workable and can not be further processed by cutting in any practical manner" (See present specification, page 37, lines 2-9 and lines 24-25). In other words, the goals of the present invention and the Nakashima Patent are diametrically opposed. Clearly, the Nakashima Patent teaches away from a free-cutting copper alloy in accordance with the present invention and cannot teach, or suggest, a metal phase construction comprising "not more than 5% of a β phase" and "5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14 of the present invention.

Table 1 of the Nakashima Patent lists only one Cu-Zn(Pb) alloy, Example D. This alloy is characterized as having solely a β phase matrix. The Oishi Decl., Comparative Sample No. 4 of Table I on page 19, and Exhibit A, unequivocally confirm that Example D of the Nakashima Patent has a metal phase construction consisting of only a β phase! Plainly, the Nakashima Patent does not teach, and cannot even suggest, the subject matter of claims 1-14 of the present invention because it teaches metal alloys having too much Zn, not enough Cu, and excessive amounts of β phase in the matrix construction.

The JP'429 Document

JP'429 teaches a "copper alloy having excellent corrosion resistance" that is usable for mechanical parts, hydraulic parts and valves (See JP'429, Abstract). However, the alloys

Serial No. 09/983,029
SUGI0085

Page 7

taught by JP'429 must include Cu, Zn, Sn, P, Mn and Si as indicated by Samples 7-23 in Table 1 of the reference. Consequently, the JP'429 Document cannot teach, or even suggest, the composition of the alloys recited in claims 1-11 because the "consisting essentially of" language of these claims limits their scope to the specified ingredients and those additional ingredients that do not materially affect the basic and novel characteristics of the composition. In re Herz, 190 U.S.P.Q. 461, 463 (C.C.P.A. 1976).

In the present case, none of claims 1-11 recite tin as an ingredient. As shown in Table 9 of the instant application, and as explained by Mr. Oishi in paragraphs 31 to 33 of the attached Oishi Decl., it is clear the addition of tin to the Cu-Zn(Pb) metal alloys recited in claims 1-11 would be expected to materially diminish the basic and novel Charpy Impact Value characteristics (i.e., the impact resistance) of these invention metal alloys. As described in paragraph [0075] of the specification of the present application, this adverse affect on impact resistance is seen when as little as about 1% Sn, by weight, is added to the Cu-Zn(Pb) compositions. In view of these facts, the "consisting essentially of" scope of claims 1-11 should be interpreted to exclude tin because the presence of this element is expected to materially affect the basic and novel characteristics of these claimed compositions.

Another deficiency of JP'429 is that the amount of lead in its alloys is more than 1% in order to improve machinability (See JP'429, Examples 7 to 23 of Table 1). Metal alloys containing 1% or more of Pb leach lead and are harmful to humans. JP'429 teaches the

Serial No. 09/983,029
SUGI0085

Page 8

desirability of adding lead in excess of 1% by weight, and actually teaches away from an alloy composition limited to "0.02 to 0.4%, by weight, of lead" as recited in claims 1-14 of the present invention.

Another deficiency of JP'429 is that it does not address the critical nature of the metal phase construction recited in claims 1-14. Specifically, each of claims 1-14 recite that the total phase area comprises "not more than 5% of a β phase." The requirement that there be "not more than 5% of a β phase" is a critical limitation of the metal phase construction of the alloys of the present invention, as supported by the attached Oishi Decl. As shown by the experimental data compiled in Table I of the Oishi Decl., the presence of β phase is independently related to both the amount of copper and zinc in the metal composition and the hot extrusion temperature of the Cu-Zn(Pb) alloys of the present invention. Lowering the amount of Cu while raising the amount of Zn may cause an excess amount of β phase to appear as suggested by Comparative Sample No. 7 of the Oishi Decl.. Likewise, raising the hot extrusion temperature to about 800°C can create an excessive amount of β phase as well.

To emphasize, JP'429 does not teach, or even suggest, that the total phase area comprises "not more than 5% of a β phase" as recited in claims 1-14. In fact, JP'429 is completely silent regarding metal phase construction; therefore, this reference also cannot teach, or even suggest, a metal phase construction that also includes "at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14 of the present invention.

Other differences between the teachings of JP'429 and the presently claimed invention are as follows. JP'429 teaches that Si is added for the purpose of forming intermetallic compounds with Mn. The reference teaches that the addition of Si in excess of

Serial No. 09/983,029
SUGI0085

Page 9

3% lowers the workability of the alloy and is undesirable. On the other hand, the metal alloys in accordance with the present invention include about 2.5 to 4.5%, by weight, of silicon, which exceeds the 3% limit taught by JP'429. The presently claimed amounts of silicon are recited in order to encourage the formation of sufficient γ phase to secure industrially satisfactory machinability (See above-captioned specification, page 5, lines 7-11).

JP'429 also teaches, in examples 7-23 of Table 1, that the amount of Mn added to the alloy must greatly exceed the amount of Si because the Mn is consumed by Si in order to produce the Mn-Si intermetallic compounds. JP'429, Table 1. Good machinability of such prior art alloys cannot be obtained without the addition of lead. According to the Cu-Zn(Pb) alloy recited in claim 7 of the present invention, when Si, Mn and Ni are included in the composition, it is required that the ratio of Si/Mn must not be less than 0.7. On the other hand, the examples shown in Table 1 of the JP'429 Document teach that the ratio of Si/Mn is not more than 0.68. These differences in the Si/Mn ratio are significant. There is no overlap of these ranges between the claimed invention and the prior art.

The JP'733 Document

JP'733 teaches a "manufacture of copper alloy and copper alloy material for radiator plate," which is a Cu-Zn-Sn alloy that can form cold rolled sheets. The copper alloy material taught by JP'733 necessarily includes tin. As discussed above, tin is not an element of claims 1-11, and the addition of tin would materially affect the basic and novel characteristics of the compositions recited in claims 1-11. Herz, 190 U.S.P.Q. at 463. See Table 9 of the instant application, and paragraphs 31 to 33 of the Oishi Decl.

In addition, only Example 13 in Table 1 of JP'733 even includes Pb, whereas each

Serial No. 09/983,029
SUGI0085

Page 10

claim 1-14 in accordance with the present invention requires "0.02 to 0.4 percent, by weight, of lead." The JP'733 alloy of Example 13 contains only 0.01% Pb, which is a trace amount falling outside the amount of lead claimed in the present invention. Therefore, JP'733 does not teach, or even suggest, a free-cutting copper alloy that includes "0.02 to 0.4 percent, by weight, of lead" as recited in claims 1-14.

JP'733 also does not teach, or even suggest, that the total phase area comprises "not more than 5% of a β phase" as recited in claims 1-14. In fact, JP'733 is completely silent regarding metal phase construction; therefore, this reference also does not teach, or even suggest, the metal phase construction that includes "at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

Some other differences include that JP'733 teaches silicon as an elective element ranging between 0.1% to 3%, although the maximum silicon content in the examples of JP'733, Table 1, is 1%. Also, those skilled in the art would realize that all of the alloys of Table 1 would manifest a metal phase construction that is solely made up of the α phase, which would have extremely low machinability.

The Singh Patent

The Singh Patent teaches "plumbing fixtures and fittings employing copper-bismuth casting alloys" having an extremely wide range of compositions. Copper, misch metal and bismuth are all required elements (See Singh Patent, col. 3, Table). In preferred embodiments, tin, zinc and nickel are also required elements (Singh Patent, col. 4, lines 17-22). Silicon, on the other hand, appears to be an elective element (See Singh Patent, col. 3, Table). In these respects, the metal alloys taught by the Singh Patent appear fundamentally different from the Cu-Zn(Pb) alloys of the present invention.

Serial No. 09/983,029
SUGI0085

Page 11

The Singh Patent cannot teach free-cutting copper alloys in accordance with the present invention because the Singh Patent teaches metal alloys that always include misch metal and bismuth. The misch metal is added to refine the grain and to improve the uniform distribution of bismuth, and lubricity throughout the metal alloy (Singh Patent, col. 2, lines 55-65). As shown in Figures 1 to 3 of the Singh Patent, such a uniform lubricious Cu-Bi metal alloy would have a uniform α phase matrix. As taught in Figures 4 to 6 of the Singh Patent, the addition of both bismuth and misch metal to a Cu-Zn metal alloy materially alters the grain structure of the alloy (Singh Patent, col. 7, line 60 to col. 8, line 9).

The combination of misch metal and bismuth is not an element of the claimed invention as recited in claims 1-11. The Singh Patent teaches that the addition of both misch metal and bismuth would materially affect the basic and novel grain structure and phase characteristics of Cu-Zn compositions such as those recited in claims 1-11. Herz, 190 U.S.P.Q. at 463. Therefore, the scope of claims 1-11 would reasonably exclude the combination of bismuth and misch metal from the claimed metal composition.

Another significant deficiency of the Singh Patent is that it cannot teach a metal alloy composition having the total phase area comprised of "not more than 5% of a β phase" with the metal phase construction including "at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14. In fact, the Singh Patent teaches copper-bismuth-misch metal alloys having a metal phase construction comprised solely of the α phase as shown in Figures 1 to 6. Bismuth tends to form coarse granules as shown in Figures 1 and 2, and tends to make metal alloys brittle (Singh Patent, col. 2, lines 6-17). Figures 4 to 6 show that the addition of misch metal only makes the

Serial No. 09/983,029
SUGI0085

Page 12

bismuth crystal fine granules small. There is no evidence that β , γ , κ , or μ phases are present in the copper-bismuth-misch metal alloys taught by the Singh Patent.

Those skilled in the art would realize that the Singh Patent teaches adding misch metal in order to provide Cu-Bi alloys with good machinability. Specifically, bismuth is relatively insoluble and does not form a solid solution in the copper alloys. Instead, bismuth precipitates as pure globules, and is similar to lead in this regard (Singh Patent, col. 1, lines 21-28, and col. 2, lines 11-17). The addition of misch metal keeps the crystalline construction of bismuth minute and fine. On the other hand, the present invention does not substitute one crystalline forming element for another, as is the technique used by Singh to achieve improved machinability. The present invention improves machinability of the alloy through a completely different mechanism, which is by manipulating the formation of various phases in the metal phase construction.

The WO'105 Document

WO'105 teaches a "copper alloy for electronic devices" that pertains to a field unrelated to the field of making alloys for manufacturing water faucets, water supply/drainage metal fittings and valves, and other similar components of water supply lines. There is no reason to believe that the copper alloys provided by WO'105 would be useful for these purposes. The relevance of this fact is that WO'105 teaches copper alloys having poor machinability, and not free-cutting copper alloys made in accordance with the present invention.

Specifically, WO'105 teaches Cu-Zn alloys that must include copper and zinc (See WO'105, Abstract). Silicon is an elective element, whose content is limited to 3% maximum by weight, although the examples include only up to 1.5% silicon by weight. In

Serial No. 09/983,029
SUGI0085

Page 13

addition, tin appears to be included in the preferred embodiments taught by WO'105 (See WO'105, Abstract). Lead appears to be an optional element in the metal alloys taught by WO'105 (See WO'105, Abstract). In these respects, the Cu-Zn metal alloys taught by WO'105 appear fundamentally different from the Cu-Zn(Pb) alloys of the present invention because the WO'105 Document teaches Cu-Zn metal alloys that include tin, generally do not contain Pb, and include lower amounts of silicon than the 2.0 to 4.0 percent, by weight, of silicon recited in the present claims.

Another significant deficiency of WO'105 is that it cannot teach a metal alloy composition having the total phase area comprised of "not more than 5% of a β phase" with the metal phase construction including "at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14. All of the alloys shown in the examples of WO'105 would have a single phase (i.e., an α phase). There is nothing in the reference to teach, or even to suggest, that β , γ , κ , or μ phases are present in the copper-zinc metal alloys taught by WO'105. As a result, WO'105 teaches only alloys with poor machinability, and not free-cutting copper alloys in accordance with claims 1-14 of the present application.

The JP'036 Document

JP'036 teaches a "copper alloy having superior wear and corrosion resistance" wherein the copper alloy consists of copper, zinc, phosphorous, tin, aluminum, manganese and silicon and is usable for mechanical parts and hydraulic parts (See JP'036, Abstract, and Table 1, samples 7-23). The teachings of JP'036 are similar to those of the teachings

Serial No. 09/983,029
SUGI0085

Page 14

of JP'429, except that the alloys of JP'036 generally do not include lead. Only sample 17 in the JP'036 document is shown to contain lead, which is in an amount of 0.1% by weight.

It is noted that JP'429, which shares a common inventor with JP'036, refers to the JP'036 document. Specifically, JP'429 mentions that the higher Pb contents of the Cu-Zn-Sn-Pb samples in Table 1 of the JP'429 reference have superior machinability to the alloys disclosed in the JP'036 reference. Because JP'429 teaches that the Cu-Zn-Sn-Pb alloys taught therein did not have acceptable machinability until lead content was 1.0% by weight, the Cu-Zn-Sn(Pb) alloy (i.e., sample 17) taught by JP'036 does not have good machinability by the author's own admission.

The Cu-Zn-Sn(Pb) alloy shown in sample 17 of Table 1 of JP'036 includes lead, but at a percentage by weight of only 0.1%. Based upon the similarities between sample 13 in the JP'429 document and sample 17 of the JP'036 document, and the teachings of JP'429 regarding the improved machinability characteristics of the metal alloys in the JP'429 reference over the alloys of the JP'036 reference, the machinability of sample 13 is not good based on the author's own admission.

Thus, on the basis of the combined teachings of the JP'429 and JP'036 references, it is unlikely that a person of ordinary skill in the art could arrive at the free-cutting copper alloys of claims 1-14 from the teachings of JP'429 and JP'036.

In the present application, none of claims 1-11 recite tin as an ingredient. Tin would materially affect the basic and novel characteristics of impact resistance, and probably also machinability, condition of chippings produced, and corrosion resistance, of the Cu-Zn(Pb) alloys recited in claims 1-11. See Table 9 of the present application, and paragraphs 31 to 33 of the Oishi Dec.

Serial No. 09/983,029
SUGI0085

Page 15

The teachings of the JP'036 document share many of the same deficiencies as those of the JP'429 document. Specifically, neither reference teaches, nor suggests, the critical nature of the metal phase construction recited in claims 1-14. Each of claims 1-14 recite that the total phase area comprises "not more than 5% of a β phase," which is a critical limitation of metal phase construction as supported by the attached Oishi Decl.

The various constraints on the metal compositions of the metal alloys recited in claims 1-14 relates to preserving the claimed limitation that the percentage of β phase must not exceed the specified amount. The only Cu-Zn(Pb) alloy taught by JP'036 is Example 17 in Table 1, which has a Zn content of 35% by weight so the Cu content must be less than 65% by weight. JP'036 is completely silent regarding metal phase construction; however, Samples Nos. 5, 6 and Comparative Sample No. 7 of Table I of the Oishi Decl. suggest that as copper content drops below 69% by weight, an excessive amount of β phase is formed. Therefore, from the data in Table I of the Oishi Decl. and from the Zn content of 35% by weight taught by Example 17 of the JP'036 document, one can reasonably infer that, in view of the relatively low Cu content and relatively high Zn content of Example 17, there is a low likelihood that JP'036 teaches a Cu-Zn(Pb) alloy having the claimed metal phase construction. In other words, JP'036 also does not teach, or even suggest, the metal phase construction that includes "not more than 5% of a β phase" and "at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

Deficiencies of the Examiner's 103 Rejection

In view of the multiple and severe deficiencies of the teachings of the prior art references discussed above, it appears the Examiner has not established even a *prima facie* showing of obviousness against the claims of the present invention. Rather, it appears the

Serial No. 09/983,029
SUGI0085

Page 16

Examiner focused on the "gist" of the invention, which the Federal Circuit has ruled is improper. Vas-Cath, Inc. v. Mahurkar, 19 U.S.P.Q.2d 1111, 1118 (Fed. Cir. 1991).

Specifically, the prior art of record fails to teach, or even suggest, the metal phase construction recited in claims 1-14 of the present invention. The prior art can be succinctly summarized as follows:

(a) The Nakashima Patent, the closest prior art, focuses on copper-zinc metal alloys that are very hard and have poor machinability. Nakashima teaches one Cu-Zn(Pb) alloy as Example D in Table 1 of the Nakashima Patent. However, Nakashima's Cu-Zn(Pb) alloy has a Hardness Rockwell B value of 95 and a metal phase construction that comprises solely a β phase as described in Nakashima, Table 1. The 100% β phase construction of Nakashima's Example D alloy, which corresponds to Comparative Sample No. 4 of Table I of the Oishi Decl., is very different from the alloys of the present invention, which require a metal phase construction comprising "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

(b) JP'429 teaches a Cu-Zn-Sn-Pb alloy that contains too much lead, and does not teach a free-cutting copper alloy having "0.02 to 0.4%, by weight, of lead" and a metal phase construction comprising "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

(c) JP'733 teaches Cu-Zn-Sn alloys, and in Example 13 a trace of Pb (i.e., 0.01% of lead) is added. However, JP'733 does not teach a free-cutting copper alloy having "0.02 to 0.4%, by weight, of lead" and a metal phase construction comprising "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the

Serial No. 09/983,029
SUGI0085

Page 17

group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

(d) The Singh Patent teaches Cu-Bi-misch metal alloys having a metal phase construction consisting of only an α phase as shown in Figures 1 to 3. Therefore, the Singh Patent cannot teach, or even suggest, a free-cutting copper alloy having a metal phase construction comprising "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

(e) WO'105 teaches various Cu-Zn alloys with various other elements added. The alloys shown in all of the examples of WO'105 would have a single α phase. WO'105 does not teach, or even suggest, a free-cutting copper alloy having a metal phase construction comprising "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

(f) JP'036 teaches Cu-Zn-Sn alloys that include multiple other elements as well. JP'036 teaches only one Cu-Zn-Sn(Pb) alloy in Example 17, and this alloy has such a high Zn content that it cannot have "69 to 79 percent, by weight, of copper" as recited in claims 1-14. Furthermore, JP'036 is completely silent with respect metal phase construction and the Cu-Zn-Sn(Pb) alloy of Example 17, having an insufficient amount of Cu, is unlikely to have a metal phase construction with "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14.

Clearly, none of the prior art references teaches, or even suggests, a free-cutting copper alloy in accordance with the present invention that has "not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the

Serial No. 09/983,029
SUGI0085

Page 18

group consisting of a γ phase, a κ phase, and a μ phase” as recited in claims 1-14. Therefore, the Examiner has failed to establish a prima facie case of obviousness because the scope and content of the prior art does not teach, or even suggest, the claimed metal phase construction of the Cu-Zn(Pb) alloy of the present invention.

The Examiner argues that “[s]ince the instant Cu-Zn alloy compositions are overlapped by the cited references...the phases distribution as recited in the instant claims would have [been] inherently possessed by the teachings of the cited references” and cited In re Spada, 15 U.S.P.Q.2d 1655, 1658 (Fed. Cir. 1990) and In re Best, 195 U.S.P.Q. 430, 433 (C.C.P.A. 1977) in support of this position (Office Action, dated October 9, 2003, page 4, lines 4-11). However, the references themselves do not support the inherency argument factually, and the caselaw also does not support the inferences as a matter of law.

Specifically, in Spada, the court ruled that discovery of a new property for a polymer anticipated by the prior art U.S. Patent to Smith did not overcome anticipation under 35 U.S.C. § 102. Spada, 15 U.S.P.Q.2d at 1658. However, in the present circumstance, no prima facie case of anticipation under 35 U.S.C. § 102 stands against the present claims. In addition, metal phase construction is a structure and state, not a property. As evident from Exhibits A to D provided in support of the Oishi Declaration, metal phase defines the physical structure of the metal composition. Metal phase state is not a “property.” It is a structure or state and is specifically claimed. Therefore, Spada does not apply.

In Best, the court held that the prior art U.S. Patent to Hansford taught all of the claimed features of a process for producing hydrothermally stable zeolite compositions except for the “expressed rate of cooling.” Best, 195 U.S.P.Q. at 432. The court ruled that inherent to the Hansford Patent was the presumption that a rate of cooling typically used in the laboratory would produce the zeolite composition, and that the inventor could have

Serial No. 09/983,029
SUGI0085

Page 19

overcome this presumption of inherency by showing that typical rates of cooling did not produce the desired zeolite composition. *Best*, 195 U.S.P.Q. at 432-3.

The caselaw established in *Best* does not apply to the present case because the Nakashima Patent does not teach the compositions and metal phase constructions recited by claims 1-14 of the present invention. Specifically, only Example D in Table 1 of the Nakashima Patent is even a Cu-Zn(Pb) alloy, and it has a metal phase construction consisting solely of β phase as described in Table 1 of the Nakashima Patent, and as confirmed by the data compiled in the Oishi Decl. (See Table I on page 19, Comparative Sample No. 4).

More generally, the applicable standard for inherency is that it must flow as the natural result of the teachings of the reference. Inherency cannot be established by mere probability or possibility alone. *Continental Can Co. USA Inc. v. Monsanto Co.*, 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991). In view of this standard, it is noted that the Nakashima Patent explicitly teaches a Cu-Zn(Pb) alloy that does not have the metal phase construction as required by claims 1-14 of the present invention. In addition, the Singh Patent teaches Cu-Bi-misch metal alloys having solely an α phase construction. Similarly, Comparative Samples Nos. 1, 2, 3, 4, 7, 8.1, 8.2 and 9.1 listed in Table I on page 19 of the Oishi Decl. all demonstrate that Cu-Zn(Pb) alloys do not inherently have the metal phase construction recited in claims 1-14 of the present invention. In view of these facts, some derived directly from the prior art and some ascertained by experiment, it is established that Cu-Zn(Pb) alloys having compositions overlapping those of claims 1-14 do not inherently have the claimed metal phase construction.

Serial No. 09/983,029
SUGI0085

Page 20

Rebuttal of Examiner's Rejection under 35 U.S.C. § 103

Even though the Examiner has failed to establish a proper *prima facie* case of obviousness as shown above, Applicant submits herewith additional experimental evidence in the Oishi Decl., filed concurrently herewith, to show (a) the criticality of the metal composition (i.e., the copper and zinc content) with respect to the metal phase construction, (b) the relationship between the hot extrusion temperature and formation of the metal phase construction, and (c) the superior properties of the Cu-Zn(Pb) alloys of the present invention over alloys of the Nakashima Patent, which the Examiner has acknowledged represents the closest prior art (See Examiner Interview Summary, dated December 16, 2003).

First, as shown by Samples Nos. 5 and 6 in Table I on page 19 of the Oishi Decl., which represent alloys in accordance with claims 1 and 13 of the present invention, decreasing the copper content and increasing the zinc content critically affects the metal phase construction and can result in a Cu-Zn(Pb) alloy, such as Comparative Sample No. 7. The metal alloy of Comparative Sample No. 7 is not a metal alloy in accordance with the present invention because it includes 10% β phase. As also shown in Table I of the Oishi Decl., Comparative Sample No. 7 requires a greater cutting force, has an unacceptably poor resistance to corrosion, and produces the undesirable spiral arc cuttings when machined. Thus, the criticality of the amount of copper and zinc with respect to the metal phase construction has been shown by the data in Table I of the Oishi Decl.

Second, as shown by Sample No. 6, and Comparative Samples Nos. 9.1 and 9.2, in Table I of the Oishi Decl., changing the hot extrusion temperature affects metal phase construction formation of Cu-Zn(Pb) alloys. Specifically, hot working temperatures for Cu-Zn(Pb) alloys of the prior art are generally in the range 650°C to 850°C (See Section

Serial No. 09/983,029
SUGI0085

Page 21

No. 18 of the Oishi Declaration). However, Comparative Sample No. 9.1, formed by hot extrusion of a Cu-Zn(Pb) ingot having the same metal composition as Sample No. 6 and Comparative Sample No. 9.2, is not a metal alloy in accordance with the present invention because it includes 10% β phase. As shown in Table I of the Oishi Decl., Comparative Sample No. 9.1 requires a greater cutting force, has an unacceptably poor resistance to corrosion, and produces the undesirable spiral arc cuttings when machined. On the other hand, Sample No. 6 and Comparative Sample No. 9.2 are Cu-Zn(Pb) alloys made in accordance with the present invention and these alloys manifest lower required cutting forces, have significantly better corrosion resistance than Comparative Sample No. 9.1, and produce the desired cuttings when machined.

Third, metal alloy Samples Nos. 5 and 6, which represent the present invention, were significantly superior to Comparative Samples Nos. 1 to 4, which represent or approximate the metal alloys of the Nakashima Patent, as shown by the comparative data in Table I on page 19 of the Oishi Decl. Specifically, Samples Nos. 5 and 6 required substantially less cutting force than the hard alloys of Comparative Samples Nos. 1 to 4, by a factor of almost 2. In addition, the cutting tests showed that only Samples Nos. 5 and 6 produced the desired metal cuttings when machined, whereas Comparative Samples Nos. 1 to 4 produced spiral winding cuttings that are not easy to recycle and that can damage the cutting tool.

Conclusion

The rejection under 35 U.S.C. § 103 is untenable and must be withdrawn because none of the six prior art references teach, or suggest, either alone or in combination with each other, a free-cutting copper alloy that includes "not more than 5% of a β phase, and 5-

Serial No. 09/983,029
SUGI0085

Page 22


70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase" as recited in claims 1-14. In addition, Applicant has shown that the prior art of record, and experimental evidence filed with the Oishi Decl., establish that the claimed metal phase construction is not inherent to Cu-Zn(Pb) alloys in general, but is a feature of the Cu-Zn(Pb) alloys made in accordance with the present invention. Lastly, Applicant has provided experimental evidence that shows (a) the criticality of copper and zinc content on β phase formation, (b) the relationship between hot extrusion temperature and β phase formation, and (c) the superior and unexpected improvements in required cutting force and the condition of cuttings produced during cutting of Cu-Zn(Pb) alloys of the present invention over the Cu-Zn(Pb) alloy taught by the Nakashima Patent, and comparative samples even closer to the present invention than the Nakashima Patent.

For the above reasons, the rejections of record should be reconsidered and withdrawn and the claims allowed.

Questions are welcomed by the below signed attorney for the Applicant.

Respectfully submitted,

GRIFFIN & SZIPL, PC


Joerg-Uwe Saip
Reg. No. 31,799

GRIFFIN & SZIPL, PC
Suite PH-1
2300 Ninth Street, South
Arlington, VA 22204

Telephone: (703) 979-5700
Facsimile: (703) 979-7429
Customer No.: 24203

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:) Atty. Docket No.: **SUGI0085**
Keiichiro OISHI) Confirmation No.: 8194
Serial No. 09/983,029) Group Art Unit: 1742
Filed: October 22, 2001) Examiner: SIKYIN IP
For: COPPER/ZINC ALLOYS HAVING)
LOW LEVELS OF LEAD AND GOOD)
MACHINABILITY)

DECLARATION OF KEIICHIRO OISHI UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

1. I, Keiichiro OISHI, state that I am an expert in the field of metal alloy research and development. Specifically, I am the head of the Research and Development Center at Sambo Copper Alloy Co., Ltd., 8-374, Sambo-cho, Sakai-shi, Osaka, Japan, 590-0906 (hereafter, the "Sambo R&D Center").

2. I am familiar with the above captioned application and claims. In this declaration, I submit experimental evidence demonstrating the superior and unexpected properties achieved by the free-cutting copper alloys in accordance with the present invention, as defined by claims 1-14 of the above captioned patent application, over the closest prior art, and to provide my testimony regarding the effects of metal phase on the characteristics of metal alloys. Metal alloys made in accordance with the present invention are intended for use in manufacturing water faucets, water supply/drainage metal fittings and valves, and like components for water supply lines, and therefore must have excellent machinability characteristics.

Serial No. 09/983,029
SUGI0085

Page 2

3. The following experimental results are the product of tests lead by me and conducted under my supervision at the Sambo R&D Center from December 2003 to January 2004.

4. The present experiment consisted of comparing metal alloy Comparative Samples No. 1 to No. 4 (corresponding to or approximating the prior art with modifications as discussed below) with Samples Nos. 5 and 6 (present invention), and Sample No. 7 (modified alloy). See Table I attached hereto. Comparative Samples Nos. 8.1, 8.2, 9.1 and 9.2 were tested to demonstrate the effect of subjecting metal alloy compositions to hot extrusion temperatures at the upper and lower working temperature limits for Cu-Zn(Pb) alloys.

Samples Modeling Nakashima's Alloys

5. The closest prior art to the metal alloys in accordance with claims 1-14 of the present invention is believed to be the Cu-Zn alloys of Examples A through C, and the Cu-Zn(Pb) alloy of Example D, shown in Table 1 of U.S. Patent 5,582,281 (hereafter, the "Nakashima Patent"). However, these alloys of Examples A through D are relatively hard, poorly machinable metals, having Hardness Rockwell B values of more than 80, and are intended for use to make sliding members for a vehicle transmission (See Abstract of Nakashima Patent).

6. The corresponding Cu-Zn(Pb) alloys of Comparative Samples No. 1 to No. 3 used in the present experiment have almost the same compositions as the Cu-Zn alloys of Examples A through C of Table 1 of the Nakashima Patent. However, because Pb content greatly affects machinability, 0.2% of Pb was added by weight to the compositions of Examples A through C of the Nakashima Patent to provide metal alloy compositions for Comparative Samples No. 1

Serial No. 09/983,029
SUGI0085

Page 3

to No. 3 with enhanced machinability characteristics. Without the addition of some Pb, those skilled in the art would expect that these metal alloy compositions taught by the Nakashima Patent, having Hardness Rockwell B values of 80 or more, would have exceptionally poor machinability characteristics. In general, as the hardness of a metal increases, the machinability tends to decrease. However, the κ , γ and μ phases formed in copper alloys of the present invention work to improve machinability even for hard metals. Consequently, while some of the copper alloys made in accordance with the present invention have maximum Hardness Rockwell B values of about 95, these metals still have superior machinability as a result of the claimed combination of phases.

7. Thus, I believe that the addition of lead in small amounts was a reasonable modification of the exact Cu-Zn compositions taught by the Nakashima Patent, and results in comparison alloys that are closer to the present invention than those cited in the prior art of the Nakashima Patent. In other words, Comparative Samples Nos. 1 to 3 are experimental alloys created to more closely approximate, or model, the Cu-Zn(Pb) alloys of the present invention than would be achieved by comparing the unmodified Cu-Zn alloys of the Nakashima Patent.

8. On the other hand, the Cu-Zn(Pb) alloy of Comparative Sample No. 4 corresponds to the Cu-Zn(Pb) alloy of Example 4 of the Nakashima Patent within acceptable experimental error.

Samples Representing the Present Invention

9. Samples No. 5 and No. 6 are free-cutting copper alloys made in accordance with the broad first embodiment of the present invention, which is recited in original claim 1 and

Serial No. 09/983,029
SUGI0085

Page 4

covered by the scope of original claim 13. Samples Nos. 5 and 6 are Cu-Zn(Pb) metal alloys having percentages of β phase that are extremely small (i.e., about 1% and 4%, respectively). These alloys each have 0.15% of Pb by weight.

Comparative Sample No. 7

10. Comparative Sample No. 7 is a free-cutting copper alloy similar to those of Samples Nos. 5 and 6, except that the percentage of β phase is 10% of the metal phase construction. Comparative Sample No. 7 is included to demonstrate the undesirable effect on the state of chippings and corrosion resistance when β phase is present in excess of 5%. Comparative Sample No. 7 is an alloy containing 0.15% of Pb by weight.

11. Sample Nos. 1 to 7 were formed as described at paragraph [0050] of the above-captioned specification. Specifically, Samples Nos. 1 to 7 were formed as round bars having circular cross-section with an outside diameter of 15 mm, with the compositions and metal phase constructs given in Table I, by heating cylindrical ingots of 100 mm in outside diameter and 150 mm in length to 750°C and hot-extruding the same. The cylindrical ingots had the compositions given in Table I attached hereto.

12. Comparative Samples Nos. 8.1 and 8.2 have the same metal alloy composition as Comparative Sample No. 4; therefore, cylindrical ingots of the same metal alloy composition were used to form Comparative Samples Nos. 4, 8.1 and 8.2. However, Comparative Samples Nos. 8.1 and 8.2 were produced by heating the cylindrical ingots to 800°C and 650°C, respectively, and hot extruding the same. Likewise, Comparative Samples Nos. 9.1 and 9.2 have the same metal alloy composition as Sample No. 6 (present invention); therefore,

Serial No. 09/983,029
SUGI0085

Page 5

cylindrical ingots of the same metal alloy composition were used to form Samples Nos. 6, 9.1 and 9.2. However, Comparative Samples Nos. 9.1 and 9.2 were produced by heating the cylindrical ingots to 800°C and 650°C, respectively, and hot extruding the same.

The Cutting Tests

13. Cutting tests were then carried out on each sample in accordance with the technique described in paragraph [0052] of the present specification. Specifically, each sample was cut on its circumferential surface using (i) a lathe provided with a point nose straight tool at a rake angle of ~ 8 degrees, (ii) at a cutting rate of 50 meters/min, (iii) to a cutting depth of 1.5 mm, and (iv) at a feed rate of 0.11 mm/rev. The cutting tests allowed evaluation and comparison of the various samples on the basis of (a) cutting force, (b) condition of chippings, and (c) the cut surface condition.

14. Signals from a three-component dynamometer mounted on the point nose straight tool were converted into electric voltage signals, which were then converted into cutting resistance. While cutting resistance is the sum of three component forces (i.e., cutting force, feed force, and thrust force), the feed force and thrust force are negligible under the conditions of the present experiments so the cutting resistance is approximately equal to the cutting force. The results of the measurements of cutting resistance are provided in Table I, attached hereto.

Evaluation of Chippings

15. Chippings from the cutting test were collected, examined and classified in accordance with the four forms (A) to (D) shown in Figure 1, and described in paragraph [0053], of the present application. Specifically, the chippings were classified as follows: (A) fine needle,

Serial No. 09/983,029
SUGI0085

Page 6

represented as "o;" (B) best chippings, represented as "•;" (C) spiral arc, represented as "Δ;" and (D) spiral windings, represented as "x" in Table I. The desired chippings are the "best chippings." The disadvantages of the fine needle, spiral arc, and spiral windings chipping forms are discussed in paragraph [0053] of the present specification. The results of evaluating the condition of the chippings are provided in Table I.

Cut Surface Condition Evaluation

16. The surface condition of the cut metal surface was also evaluated after cutting to determine the maximum roughness (R_{max}), which is a commonly used standard in the art for measuring surface roughness as described in paragraph [0054] of the present specification. Specifically, alloys with an $R_{max} < 10$ microns are generally considered to have excellent machinability (represented by "o" in Table I), whereas alloys with an R_{max} in the range $10 \text{ microns} \leq R_{max} < 15 \text{ microns}$ are generally considered to be industrially acceptable (represented by "Δ" in Table I), and alloys with an $R_{max} \geq 15 \text{ microns}$ are generally judged to have poor machinability (represented by "x" in Table I). The results of the determination of the cut surface state for each sample are provided in Table I.

De-zinc-ing Corrosion Test

17. Sample Nos. 5, 6, 7, 9.1 and 9.2 were also subjected to the de-zinc-ing corrosion test in accordance with the "ISO 6509" method, which is a standard test in the art described in paragraph [0061] of the present specification. Specifically, each one of these samples was embedded in a phenolic resin in such a way so that the exposed sample surface is perpendicular to the extrusion direction of the sample. The surface of the sample was then polished with emery paper No. 1200, and then ultra-sonic washed in pure water and dried.

Serial No. 09/983,029
SUGI0085

Page 7

After this initial preparation, each prepared sample was dipped in a 12.7 g/l aqueous solution of cupric chloride dihydrate ($\text{CuCl}_2 \cdot 2 \text{H}_2\text{O}$) 1% and left standing for 24 hours at 75°C. Each dipped sample was then taken out of the aqueous solution and the maximum depth of de-zinc-ing corrosion was then measured. The results of the de-zinc-ing corrosion test are provided in Table I.

Background Discussion

18. Before discussing the data provided in Table I, I will discuss the following background information for the record. First, the amount and kind of metal phase construction forming metal materials is affected (a) by the alloy composition, (b) by the processing/production conditions (i.e., the hot extrusion temperature) and (c) by the processing method. The data in Table I provides examples showing how independently both the hot working temperature and the metal composition can affect the percentage amount of phase β as well as the percentages of other metal phases that form the alloy. For example, Samples Nos. 5 and 6 and Comparative Sample No. 7 show that when the processing conditions and the processing methods have been determined, then a critical metal composition can be determined where the β phase is formed as 5% or less of the total phase construction.

19. In other words, while the critical value of the β phase (i.e., 5% or less) is determined by three parameters, which are (i) metal composition, (ii) processing conditions (i.e., the extrusion temperature), and (iii) the processing method, fixing two of these parameters (i)-(iii) allows for the critical value of the third parameter to be determined that corresponds to the formation of the critical value of the β phase (i.e., β phase is 5% or less). Consequently, those skilled in the art would realize that three parameters determine when the β phase will reach the

Serial No. 09/983,029
SUGI0085

Page 8

critical value and the β phase critical value of 5% is not determined solely on the basis of metal composition alone.

20. These examples also show how the machinability of the metal alloys is affected by changing the metal phase construction. For this experiment, the relative percentages of the various metal phases (i.e., α , β , γ , κ , and μ) making up the metal phase construction (i.e., total phase area) for each Sample in Table I was estimated by examining a thin slice of each sample alloy under a microscope at a magnification of 200. A photograph showing the phase construction for each sample is attached as Exhibits A, B, C and D, wherein: A shows a metal phase construction photograph for Comparative Samples Nos. 1 to 4; B shows a metal phase construction photograph for Samples Nos. 5, 6 and Comparative Sample No. 7; C shows a metal phase construction photograph for Comparative Samples Nos. 8.1 and 8.2; and D shows a metal phase construction photograph for Comparative Samples Nos. 9.1 and 9.2. The percentage of each phase was estimated as the ratio of area containing a specific phase to the total area of metal surface examined (i.e., total phase area).

21. Second, generally speaking, the hot working temperature for Cu-Zn(Pb) alloys, such as free-cutting brass JIS Designation C3604, C3602 (Copper Development Association Inc. (CDA) Designation C36000) with Pb added, and of brass for molding JIS Designation C3771 (CDA Designation C37700) with Pb added, is known to be about 650°C to 850°C. For this experiment, Comparative Samples Nos. 8.1, 8.2, 9.1 and 9.2 have been subjected to hot extrusion temperatures at the upper and lower temperature limits of the working range to demonstrate that not all temperatures in the working range cause the desired metal phase constructs to form.

Serial No. 09/983,029
SUGI0085

Page 9

Test Results and Discussion

22. As shown in Table I, Comparative Samples No. 1 to No. 4, which were made to correspond to metal alloys taught by the Nakashima Patent, but better approximate the present invention, all manifest serious disadvantages compared to the Cu-Zn(Pb) metal alloys in accordance with the present invention as represented by Samples No. 5 and No. 6. Specifically, the chippings collected and examined after cutting work was completed on each Comparative Sample Nos. 1 to 4 were the long and connected chippings of the spiral windings type even though 0.2% Pb by weight had been added to some of these alloys. On the other hand, the chippings collected and examined after cutting work was completed on each Sample Nos. 5 and 6 of the present invention were of the best chipping type. As explained in the instant specification, in paragraph [0053], metal alloys such as provided by Comparative Samples Nos. 1 to 4 are disadvantageous because spiral type chippings are generated during cutting work, which are difficult to recover or recycle, and may get tangled with the cutting tool thereby damaging the cut metal surface and the tool. In contrast, metal alloys made in accordance with the present invention, as represented by Samples Nos. 5 and 6 according to the present invention, produce the desired "best chippings," which can be efficiently recycled or recovered, and which are unlikely to damage the cut metal surface or the cutting tool.

23. As shown in Table I attached hereto, the cut surface state was not qualitatively different between the metal alloys of Comparative Samples Nos. 1 to 4 that model the prior art, and the metal alloys of Samples Nos. 5 and 6 made in accordance with the present invention.

Serial No. 09/983,029

Page 10

SUGI0085

24. As shown in Table I, the cutting force required to cut metal alloys of Comparative Samples Nos. 1 to 4, which model the prior art, is extremely great and exceeds 200 N, which is about twice the cutting force required to cut the metal alloys of Samples Nos. 5 and 6 made in accordance with the present invention. The extremely great cutting force needed to machine metal alloy Samples Nos. 1 to 4 is also about twice the cutting force required to generally machine free cutting brasses containing about 3 % lead as supported in Table 33 of the instant specification (See cutting forces for Samples Nos. 13001, 13002 and 13003, which underwent the same cutting test method as described in paragraph 11 above). Thus, the cutting force required to machine Zn-Cu(Pb) alloys made in accordance with the present invention is on the order of 100 N, which manifests a machinability property that is industrially acceptable and similar to that manifested by prior art Cu-Zn(Pb) alloys containing about 3 % Pb. On the other hand, the Zn-Cu(Pb) alloys of Comparative Samples Nos. 1 to 4, 8.1 and 8.2, which reasonably approximate the hard metal alloys taught by the Nakashima Patent, require cutting forces that are industrially out of the question. Therefore, these alloys demonstrate unsatisfactory machinability for the purpose of manufacturing water faucets, water supply/drainage metal fittings and valves, and like components for water supply lines.

Effect of Varying Extrusion Temperature on Sample No. 4

25. Furthermore, even when Cu-Zn(Pb) alloy having the same composition as Comparative Sample No. 4 is subjected to a different hot extrusion temperature, such as shown by Comparative Samples Nos. 8.1 and 8.2, the β phase of the metal construct remains very high. This phase behavior results in the observation that both the cutting resistance and the state of the chippings do not change for metal alloys having the same metal composition as

Serial No. 09/983,029

Page 11

SUGI0085

Comparative Sample No. 4 despite varying the hot extrusion temperature within the known working range for Cu-Zn(Pb) alloys. In other words, in my opinion, it is reasonable to conclude from the phase behavior of Comparative Samples Nos. 4, 8.1 and 8.2 that the machinability of Comparative Samples Nos. 1 to 3 will not be improved by altering the hot extrusion temperature.

26. In addition, the Cu-Zn(Pb) alloy Comparative Samples Nos. 1 to 4, 8.1 and 8.2 all produce the unacceptable spiral winding chippings when machined, whereas Samples Nos. 5 and 6 according to the present invention each produce the desired "best chippings." Therefore, in my opinion, it is reasonable to conclude that the production of unacceptable spiral winding chippings, when machining metal alloys made to have a composition similar to Comparative Samples Nos. 1 to 4, would be unaffected by changing the hot extrusion temperature.

Effect of Varying the Copper Content on the Present Invention Alloys

27. The machinability properties of Samples Nos. 5 to 7 demonstrate other important characteristics of Cu-Zn(Pb) metal alloys made in accordance with the present invention. Specifically, as the Cu content of a metal alloy made in accordance with Sample No. 5 is decreased while the Zn content is increased, the percentage of the β phase also increases as shown in Table I attached hereto. As the percentage of β phase increases, so too does the cutting force and the chippings tend to become more connected to each other. In fact, when the β phase reaches 10%, as occurred with Comparative Sample No. 7, the cutting resistance observed during cutting had risen to 138 N, which is about 35% higher than the cutting force used to cut generally free cutting brasses containing 3% Pb (i.e., See Samples Nos. 13001,

Serial No. 09/983,029

Page 12

SUGI0085

13002, 13003 from Table 33 of the instant specification). In addition, the character of the chippings changes when a β phase of 10% is observed. Specifically, once the β phase of the Cu-Zn(Pb) metal alloy reaches 10% (i.e., exceeds about 5%) the chippings change from the desired "best chippings" to undesirable spiral arc chippings.

28. In other words, the results for Samples Nos. 5-7 compiled in Table 1 show that, generally, as the amount of Cu is increased in the metal composition, the amount of β phase formation decreases. In these examples, the amount of Si is 2.4%. If the amount of Si is changed from 2.4%, then, depending on the amount of Si the β phase may not actually form, or conversely the β phase may form in excessive amounts (i.e., 20-30% of the phase construction), even though the amount of Cu in the metal composition remains constant.

29. Thus, while Samples Nos. 5 and 6 according to the present invention generate desirable chippings, Comparative Sample No. 7 does not. In other words, based on the nature of the chippings observed during the cutting test, it is apparent that Comparative Sample No. 7 does not have industrially satisfactory machinability. Comparison between Samples Nos. 5 and 6 of the present invention with Comparative Sample No. 7 shows that machinability of Cu-Zn(Pb) alloys depends greatly on the percentage of β phase in the metal construct. More particularly, the data proves that Cu-Zn(Pb) alloys made in accordance with the present invention, having a β phase of about 5% or less, are provided with a machinability that is satisfactory for our industrial purposes. On the other hand, similar Cu-Zn(Pb) alloys, such as represented by Comparative Sample No. 7, are not suited for industrial use due to significantly inferior machinability characteristics that result when the percentage of β phase reaches above

Serial No. 09/983,029

Page 13

SUGI0085

a critical value.

30. Discernable from the data in Table I is the fact that somewhere between 5 to 10% β phase the machinability of the metal alloy becomes unacceptable. Thus, it is critical that the machinability of Cu-Zn(Pb) metal alloys, made in accordance with the present invention, have a β phase that is not more than about 5%.

Effect of β Phase on Corrosion Resistance

31. Another fact discernable from the data in Table I is the fact that as the percentage of β phase reaches 10%, the corrosion resistance of the Cu-Zn(Pb) alloy of the present invention sharply declines. Specifically, the corrosion depth for Samples Nos. 5 and 6 is about 160 and 180 μm , respectively, when dipped in 1% aqueous cupric chloride dihydrate solution for 24 hours. On the other hand, the corrosion depth for Comparative Sample No. 7 is about 310 μm , which is almost two times greater. Thus, it is clear that the corrosion resistance of Cu-Zn(Pb) metal alloys, made in accordance with the present invention, is critically dependent upon having a β phase that is not more than about 5%.

32. I believe that a person skilled in the art would recognize that deterioration in corrosion resistance is a serious practical problem for those metal alloys intended to be used to manufacture metal water supply stopcocks and valves. Specifically, a lead containing metal alloy having poor corrosion resistance, such as represented by Comparative Sample No. 7, may have lower amounts of Pb than conventional free cutting brasses containing 3% Pb, but when the metal rapidly corrodes whatever amount of lead that is present would readily leach

Serial No. 09/983,029

Page 14

SUGI0085

into the water supply. Thus, an easily corroded Cu-Zn(Pb) metal alloy, such as represented by Comparative Sample No. 7, would be unsuitable for use in manufacturing components for water supply lines due to the health risk it would cause.

Effect of Extrusion Temperature on β Phase Formation

33. The data in Table I also demonstrates the affect of hot extrusion temperature on the percentage of β phase formation and various other characteristics of Cu-Zn(Pb) alloys made in accordance with the present invention. Specifically, when Sample No. 6 and Comparative Samples Nos. 9.1 and 9.2 are compared, it becomes apparent that decreasing the hot extrusion temperature from 750°C used in forming Sample No. 6 to 650°C used in forming Comparative Sample No. 9.2 produced no significant difference with regard to the percentage of β phase and $\gamma+\kappa+\mu$ phases formed in the metal phase construction. Consequently, there was no significant difference observed in the condition of chippings, cut surface state, cutting force required, and corrosion depth characteristics between Sample No. 6 of the present invention and Comparative Sample No. 9.2. On the other hand, when the hot extrusion temperature is increased to 800°C, such as is the case for Comparative Sample No. 9.1, the formation of β phase increases to 10% and the formation of the $\gamma+\kappa+\mu$ phases decreases to 10% in the metal construction. Corresponding changes in metal alloy properties are seen as a result of these changes in phase construction.

34. The metal phase construction of Comparative Sample No. 9.1 is similar to the phase construction in Comparative Sample No. 7, albeit this similar phase construction is the result of altering the hot extrusion temperature and not the metal composition. Consequently,

Serial No. 09/983,029

Page 15

SUGI0085

Comparative Sample No. 9.1 has metal alloy characteristics similar to Comparative Sample No. 7. In other words, Comparative Sample No. 9.1 requires a greater cutting force (i.e., almost 1.1-1.15 times that required for Samples Nos. 5, 6 and Comparative Sample No. 9.2), generates undesirable spiral chippings, and is significantly less corrosion resistant than Samples Nos. 5, 6 and Comparative Sample No. 9.2 (i.e., corrosion depth is almost twice).

35. The data in Table I shows the effect of hot extrusion temperature when forming Cu-Zn(Pb) alloys made in accordance with the present invention. When hot extrusion temperature is too high (i.e., around 800°C), an excess of β phase is formed thereby causing the following disadvantages: (a) an undesirable increase in cutting force, (b) the production of undesirable chippings during cutting, and (c) an undesirable decrease in corrosion resistance. As discussed above with respect to Comparative Sample No. 7, these disadvantages renders the metal alloy of Comparative Sample No. 9.2 unsuitable for manufacturing components for water supply lines in view of the industrially unsatisfactory machinability, the undesirable condition of the chippings, and in view of the unsatisfactory corrosion resistance.

36. As previously discussed, the kinds of phases formed, and the percentages of these phases, is not determined solely by the composition of the metal. Likewise, the formation of metal phase construction is not determined solely by the hot extrusion temperature alone. For instance, the Comparative Sample No. 9.1, which has the same metal composition as Sample No. 6, shows that when the processing method is also fixed, the referred extrusion temperature is determined to be about 750°C-800°C. In other words, from the particular fixed metal composition and processing method parameters used in making Samples Nos. 6 and 9.1, it is

Serial No. 09/983,029

Page 16

SUGI0085

evident that β phase formation in excess of 5% occurs around 750°C-800°C. However, the temperature range values of 750°C-800°C that make up the critical temperature range may fluctuate or shift to 760°C-830°C depending upon the diameter of the extruded metal ingots, the extrusion speed, and the selected processing method (e.g., the cooling speed).

37. Consequently, the critical extrusion temperature is determinable only when both a particular metal composition is selected and a particular processing method has been determined. Although an extreme case, it is possible to select a certain metal alloy composition and a certain processing method so that the β phase of the phase construction is maintained at 5% at all extrusion temperatures. In such a case, there would be no critical extrusion temperature.

Effect of Adding Tin to the Present Invention Alloys

31. When Sn is added to a metal alloy, the result is that the alloy becomes brittle and its Charpy Impact Value is lowered as explained using Example 3, described in paragraphs [0072] through [0075] of the present specification. Ductility is also lowered when Sn is included in the metal alloy. Alloys with a low Charpy Impact Value are not as suited for use as materials for making products needing caulking after the cutting process. That is to say, materials for such products need high impact resistance in addition to good machinability characteristics. Products needing caulking after the cutting process, include, for example, tube connectors called nipples, metal pieces such as hinges for furniture, automobile sensor parts, and the like.

Serial No 09/983,029

Page 17

SUGI0085

32. Table 9 of the present application contains a compilation of Charpy Impact Value comparison testing data between Cu-Zn(Pb) alloys manufactured with and without Sn. Table 9 of the present specification has been reproduced and attached herewith as Table II for the Examiner's convenience. The copper alloys (Nos. 1-6) are all listed as embodiments in the Specification of the present application. The data in Table 9 of the instant application demonstrates the great reduction in Charpy Impact Value caused by the addition of Sn to Cu-Zn(Pb) metal alloys. I believe those skilled in the art would be aware that the Charpy Impact Value can be obtained by dividing Charpy absorption energy by the notch sectional area, and that a material having a low Charpy Impact Value is a material having a small absorption relaxation ability against impact. In other words, a material that has a low Charpy Impact Value is a brittle material. As discussed in paragraph [0074] of the above-captioned specification, the impact test method employed to obtain the above results is the "Metal materials impact test method" categorized under JIS Z 2242. The testing machine was the "Charpy impact test machine" categorized under JIS B 7722, and the test pieces used were the "U notch test piece" categorized under JIS Z 2202.

33. As evident from Table 9 of the present specification, the Charpy Impact Values of Copper Alloys No. 2 and No. 5, both containing Sn, are far smaller than the Charpy Impact Values of Copper Alloys No. 1, No. 3, No. 4 and No. 6, which do not contain Sn. I believe this data conclusively shows that the addition of tin to Cu-Zn(Pb) metal alloys, such as those recited in claims 1-11 of the present application, would materially diminish the basic and novel Charpy Impact Value characteristics of the metal composition of the presently claimed invention.

Serial No/ 09/983,029

Page 18

SUGI0085

Conclusions

34. In my expert opinion, the comparative data compiled in Table I attached hereto, and as explained above, supports the following conclusions:

- (a) the percentage of β phase in the metal phase construction of Cu-Zn(Pb) metal alloys made in accordance with the present invention is dependent upon both the percentage of Cu in the alloy composition and the hot extrusion temperature used during formation of the alloy;
- (b) the percentage of β phase in the metal phase construction of Cu-Zn(Pb) metal alloys made in accordance with the present invention has a profound effect on the machinability characteristics of the alloy (i.e., the cutting force required when machining and the condition of chippings produced when machining);
- (c) the percentage of β phase in the metal phase construction of Cu-Zn(Pb) metal alloys made in accordance with the present invention has a profound effect on corrosion resistance of the alloy;
- (d) the advantageous machinability and corrosion resistance characteristics of Cu-Zn(Pb) metal alloys made in accordance with the present invention are critically dependant upon having a percentage of β phase in the metal construction that is not more than about 5% as presently claimed;
- (e) that Cu-Zn(Pb) metal alloys having β phase of 10% or more (i.e., Comparative Samples Nos. 1-4, 7, 8.1, 8.2, and 9.1), and which are otherwise similar to Cu-Zn(Pb) metal alloys of the present invention, are not suited for industrial application to the manufacturing of water faucets, water supply/drainage metal

Serial No. 09/983,029

Page 19

SUGI0085

fittings and valves, and like components for water supply lines, because the machinability of such alloys having excessive amounts of β phase is not acceptable (i.e., the cutting forces required and the condition of the chippings produced while cutting are unacceptable for industrial application);

- (f) it can be reasonably inferred that the metal alloys of Examples A through C of the Nakashima Patent (the closest prior art) would be even less suited for industrial application to the manufacturing of water faucets, water supply/drainage metal fittings and valves, and like components for water supply lines, than comparative Samples Nos. 1-3 because the reported hardness of Nakashima's metal alloys would generally render their machinability impractical for our intended industrial application;
- (g) that the relatively poor machinability characteristics of Comparative Sample No. 4, which corresponds to Example D of the Nakashima Patent, was congruent with the reported hardness of such a Cu-Zn(Pb) alloy (i.e., Hardness Rockwell B value of 95, see Table 1 in the Nakashima Patent); and
- (h) that the addition of tin to the metal alloy compositions recited in claims 1-11 of the present invention would materially diminish the basic and novel Charpy Impact Value characteristics of these metal compositions.

35. I declare under penalty of perjury that the foregoing is true and correct, that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements so made are punishable by fine or

06/16/04 15:34 FAX 703 979 7429
04/04/04 13:44 FAX 06 0201 3309
04/01/04 13:03 FAX 703 879 7429

GRIFFIN AND SZIPL PC
SUGIMOTO PATENT OFFICE
GRIFFIN AND SZIPL PC

047
021
022

Serial No. 09/983,029

Page 20

SUGI0085

imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed by,

Date: April 2, 2004 Keiichiro Oishi
Keiichiro OISHI

Serial No. 09/029

Page 21

SUGI0085

TABLE I

Sample No.	Cu	Si	Pb	Zn	Al	Mn	Fe	Ni	Other elements	Metal phase constr.	$\gamma+\mu$ (%)	β (%)	Condition of Chippings	Cut Surface State	Cutting Force (N)	Corrosion Depth (μm)	Hot Extrusion Temperature ($^{\circ}\text{C}$)
Comp. 1	62.3	0.5	0.2	27.6	3.5	0	1.0	3.9	1.0 Cu	$\alpha+\beta$	0	90	x	o	216	----	750
Comp. 2	60.1	0.6	0.2	32.0	5.4	0	0.7	0	1.0 Zr	β	0	100	x	o	224	----	750
Comp. 3	57.2	0	0.2	34.8	4.9	0	1.4	1.0	0.4 Ti, 0.4 Nb	β	0	100	x	o	227	----	750
Comp. 4	56.8	1.0	0.2	38.2	1.5	2.3	0	0	----	β	0	100	x	o	218	----	750
5	72.6	2.4	0.15	24.9	0	0	0	0	----	$\alpha+\gamma+\beta$	15	~1	•	o	118	160	750
6	71.1	2.4	0.15	26.4	0	0	0	0	----	$\alpha+\gamma+\beta$	15	5 or less (~4)	•	o	123	180	750
Comp. 7	69.5	2.4	0.15	28	0	0	0	0	----	$\alpha+\gamma+\beta$	10	10	Δ	Δ	138	310	750
Comp. 8.1	56.8	1.0	0.2	38.2	1.5	2.3	0	0	----	β	0	100	x	o	217	----	800
Comp. 8.2	56.8	1.0	0.2	38.2	1.5	2.3	0	0	----	β	0	100	x	o	218	----	650
Comp. 9.1	71.1	2.4	0.15	26.4	0	0	0	0	----	$\alpha+\gamma+\beta$	10	10	Δ	Δ	137	310	800
Comp. 9.2	71.1	2.4	0.15	26.4	0	0	0	0	----	$\alpha+\gamma+\beta$	15	5 or less (~4)	•	o	122	170	650

Notes: 1. The hot extrusion of Comparative Samples Nos. 1-4 and 7 and Samples Nos. 5 and 6 was carried out with ingots heated to 750°C.

2. The hot extrusion of Comparative Samples Nos. 8.1 and 9.1 was carried out with ingots heated to 800°C.

3. The hot extrusion of Comparative Samples Nos. 8.2 and 9.2 was carried out with ingots heated to 650°C.

4. Comparative Samples Nos. 8.1 and 8.2 have the same metal alloy composition as Comparative Sample No. 4.

5. Comparative Samples Nos. 9.1 and 9.2 have the same metal alloy composition as Sample No. 6 of the present invention.

Serial No. 09/983,025
SUGI0085

Page 22

TABLE II: Impact Test Results*

[wt%]

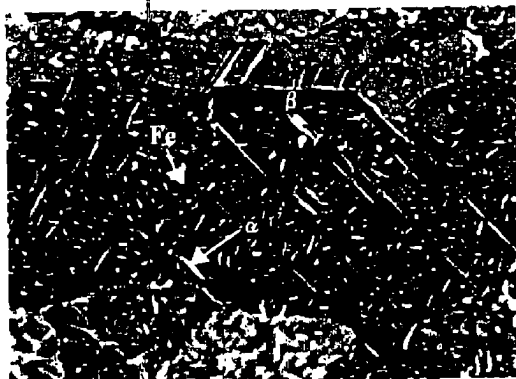
Copper Alloys No.	Cu	Si	Pb	Sn	P	Zn	Sharpy Impact Value (J/cm)
1	75.1	2.8	0.06	--	--	Remainder	59.10
2	75.0	2.6	0.06	1.07	--	Remainder	12.20
3	75.3	2.7	0.05	--	0.11	Remainder	63.00
4	76.7	3.0	0.06	--	--	Remainder	73.40
5	77.0	3.0	0.05	1.00	--	Remainder	9.90
6	77.1	3.1	0.05	--	0.10	Remainder	63.40

*This table is a reproduction of Table 9 of U.S. Patent Application Serial No. 09/434,498, filed October 22, 2001.

SUB 4403
09/983,029

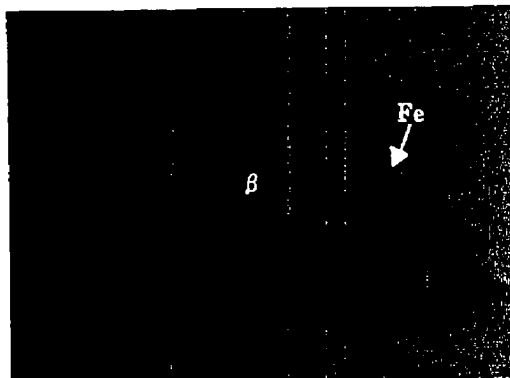
EXHIBIT

A



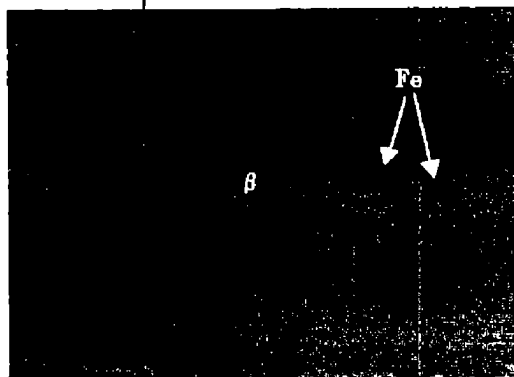
Sample 1 × 200

62.3Cu-27.6Zn-0.5Si-0.2Pb-3.5Al-1Fe-3.9Ni-
1Co の金属組織



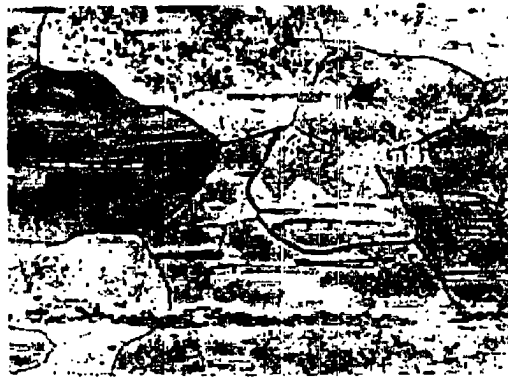
Sample 2 × 200

60.1Cu-32Zn-0.6Si-0.2Pb-5.4Al-0.7Fe-1Zr
の金属組織



Sample 3 × 200

57.2Cu-34.8Zn-0.2Pb-4.9Al-1.4Fe-1Ni-0.4Ti-
0.1Nb の金属組織



Sample 4 × 200

56.8Cu-38.2Zn-1Si-0.2Pb-1.5Al-2.3Mn
の金属組織

SUGL 4482
09/983,029

EXHIBIT

B



Sample 5 ×200

71.5Cu-26Zn-2.4Si-0.15Pb

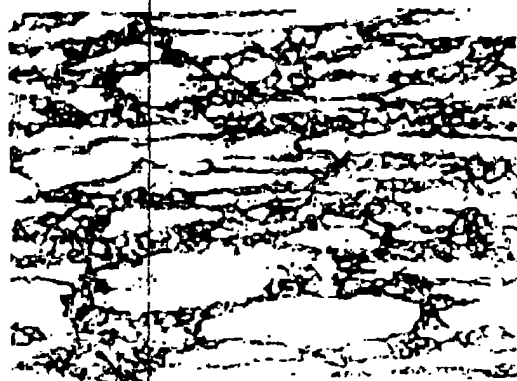
の金属組織



Sample 6 ×200

70.4Cu-27.1Zn-2.4Si-0.15Pb

の金属組織



Sample 7 ×200

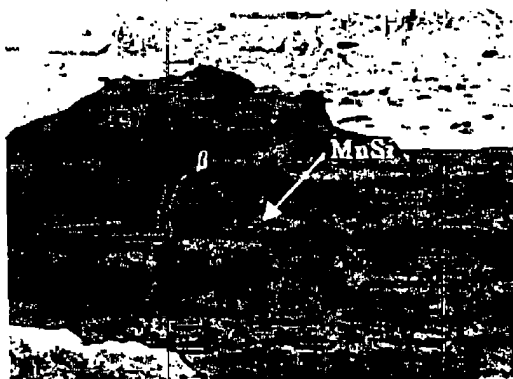
69.3Cu-28.2Zn-2.4Si-0.15Pb

の金属組織

SUB 4400
09/983,029

EXHIBIT

C



Sample 8.1 ×200

56.8Cu-38.2Zn-1Si-0.2Pb-1.5Al-2.3Mn
の金属組織



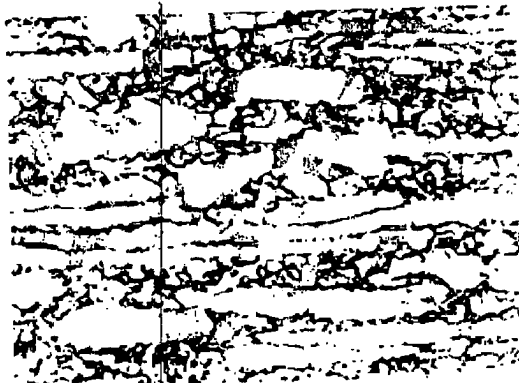
Sample 8.2 ×200

56.8Cu-38.2Zn-1Si-0.2Pb-1.5Al-2.3Mn
の金属組織

SUGL WP85
09/983,029

EXHIBIT

D



Sample 9.1 $\times 200$

70.4Cu-27.1Zn-2.4Si-0.15Pb

の金属組織



Sample 9.2 $\times 200$

70.4Cu-27.1Zn-2.4Si-0.15Pb

の金属組織